

REMARKS

As discussed in the telephonic interview with Examiner Gillespie on January 11, 2009, an article by FLORY was discussed in the previously filed amendment, but the Official Action did not discuss the article. A copy of this article is provided in the appendix of this amendment, along with a similar discussion of this article.

Claim 1 is amended in a manner to place the application in condition for allowance. Reconsideration and allowance of the application is respectfully requested.

Status of the Claims

Claim 1 is amended for clarity. The short and narrow recitations are deleted, as these expressions are believed to be unnecessary in view of the definitions of y and z recited in claims. However for further clarity, the y segment, i.e., the segment including R2 and R1, is described as the hard block length as is apparent from the specification as whole, e.g., at page 9, lines 5-9, page 10, lines 9-10, and page 24, line 6 to page 25, line 2. The z segment is also now described as the polymer length.

Claims 1-20 remain in this application.

Claim Rejections-35 USC §112

Claims 1-20 were rejected under 35 U.S.C. §112, second paragraph, for being indefinite. This rejection is respectfully traversed for the reasons below.

The position of the Official Action was that the expressions "short prepolymer" and "narrow distribution" renders claim 1 indefinite, as "short" and "narrow" are relative terms.

However, the "short" prepolymer and "narrow" distribution of hard and soft block lengths, are related to the production method of the prepolymer, e.g., "adding...at a slow rate...at a temperature of 50-60°C...said esterdiol and said aromatic diisocyanate are added in such amounts that the molar ratio between R2 and R3 is larger than 2:1."

The result of this method is that the prepolymer becomes "short", the amount of unreacted diisocyanate becomes small, and the latter in turn results in "narrow" length distribution of the hard and soft blocks. However, this result is also described by the recited " $0 < y < 4$ ", where "y" is the length of the hard block segments of the polymer.

Thus, the expression "a short prepolymer and a narrow distribution of hard and soft block lengths" is actually a repetition of the properties of the prepolymer and the effect of these properties on the final polymer. A more concise alternative to the expression is "...said rate is sufficiently slow so that said prepolymer provides $0 < y < 4$ in said linear block polymer".

Accordingly, claim 1 is amended to recite the more concise alternative, and clarify the meaning of "y" and "z".

Therefore, withdrawal of the rejection is respectfully requested.

Claim Rejections-35 USC §103

Claims 1-20 stand rejected under 35 USC §103(a) as being unpatentable over FLODIN US 6,210,441 ("FLODIN"). The rejection is respectfully traversed for the reasons below.

The position maintained was that it would have been obvious to modify Example 5, which shows a NCO:OH ratio of 4.5:1, and select 60°C as the reaction temperature, as column 4 lines 40-43 of FLODIN discloses that the reaction temperatures are not limited to 70°C as the minimum.

However, FLODIN does not suggest a linear block polymer having a particular hard block length "y", i.e., $0 < y < 4$.

The claimed "y" value depends by both (i) the stoichiometric ratios of the reactants and (ii) the process by which the reactants are allowed to react with each other.

As to the process in particular, even if similar average NCO:OH ratios are used to form prepolymers, the manner in which the reactants are added determines the characteristics of the resulting prepolymers. That is, the faster that one mixes the reactants to form the prepolymer, the wider distribution of chain lengths with a higher number of long prepolymer molecules and a higher number of "un-reacted" diisocyanate molecules one

obtains. Moreover, even if the same NCO/amine ratio is used in two reactions used to form block polymers, the resulting block polymers may have different hard block lengths, depending on the amount of unreacted diisocyanate with the prepolymers. The higher the number of unreacted molecule present with the prepolymer, the greater the length of the hard blocks of the product polymer formed after the amine is added to the prepolymer.

Thus, without the slow addition of esterdiol at a low temperature in the absence of a catalyst, it is very difficult to obtain a polymer with $0 < y < 4$ if no particular subsequent action is taken to remove unreacted diisocyanate, even with a diisocyanate/esterdiol molar ratio larger than 2:1 when preparing the prepolymer.

FLODIN does not recognize a need for the removal of unreacted diisocyanate, nor does FLODIN suggest a polymer having the claimed y -value, or hard block length, could be obtained by changing the production parameters (lower temperature, no catalyst etc.). Thus, there would have been no incentive for a skilled person in the art to try parameters different than those described in the examples of FLODIN.

Indeed, as evidenced by P. J. FLORY, which discussed in the previously filed amendment, the issue of unreacted diisocyanate was common general knowledge that still is applied in polymer science (J. Am. Chem. Soc., 58, (1936), 1877-1885). A

copy of this article is provided in the appendix of this amendment.

By using FLORY's description and assuming all diisocyanate and all diol are mixed at once and also assuming completeness of reaction, i.e. all diol groups are reacted as there is excess diisocyanate, the following results from equation 30b in the FLORY article.

An NCO/OH-ratio of 1.6 results in 37 mol-% of the diisocyanate being unreacted in the prepolymer, and more than 20 mol-% of the diisocyanate is incorporated in prepolymer molecules of 9 monomeric units or longer.

An NCO/OH-ratio of 2 results in 50 mol-% of the diisocyanate being unreacted in the prepolymer, and more than 6 mol-% of the diisocyanate is incorporated in prepolymer molecules of 9 monomeric units or longer.

An NCO/OH-ratio of 2.4 results in 58 mol-% of the diisocyanate being unreacted in the prepolymer, and more than 3 mol-% of the diisocyanate is incorporated in prepolymer molecules of 9 monomeric units or longer.

The NCO/OH-ratio of 2 will further result in an average hard block length corresponding to a "y"-value of over 4, based on the results calculated from FLORY's description. Moreover, increasing the NCO/OH-ratio above 2 will result in increasing amounts of unreacted monomeric diisocyanate and an NCO/OH-ratio of 2.4 will result in an average hard block length corresponding to a "y"-value of over 5.

As can be seen from these calculations, the two requirements of (i) more urea than urethane groups and (ii) very short hard blocks contradict each other. Increasing the NCO/OH-ratio in the prepolymer reaction increases the amount of unreacted monomeric diisocyanate in the prepolymer which leads to longer hard blocks in the final polyurethane urea.

Thus, common general knowledge at the time the invention was made (e.g., the FLORY-article) was that using a high R_2/R_1 ratio results in large amounts of unreacted diisocyanate which in turn results in long hard blocks and thus an y-value of greater than 4.

Therefore, to increase the NCO/OH ratio above 2 and to keep the hard block length "y" of all polymer chains less than 4 would have been unobvious to those skilled in the art. It would have been further unobvious that a process of slow addition, drop by drop of diol to a bulk of diisocyanate at a temperature at or below 60°C would give desired material properties with respect to toughness, elongation and degradation.

Therefore, the proposed combination does not render obvious the claimed invention, and withdrawal of the rejection is respectfully requested.

Conclusion

In view of the amendment to the claims and the foregoing remarks, this application is in condition for allowance


at the time of the next Official Action. Allowance and passage to issue on that basis is respectfully requested.

Should there be any matters that need to be resolved in the present application, the Examiner is respectfully requested to contact the undersigned at the telephone number listed below.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to our credit card which is being paid online simultaneously herewith for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

YOUNG & THOMPSON

/Robert A. Madsen/ 
Robert A. Madsen, Reg. No. 58,543
209 Madison Street, Suite 500
Alexandria, VA 22314
Telephone (703) 521-2297
Telefax (703) 685-0573
(703) 979-4709

RAM/jr

APPENDIX:

The Appendix includes the following item(s):

-Paul J. FLORY, J. Am. Chem. Soc., 58, (Oct., 1936, pages 1877-1885; Dec., 1942, page 3067), "Molecular Size Distribution in Linear Condensation Polymers".